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Abstract

FABRICATION OF FUEL ELEMENTS FOR RESEARCH REACTORS.

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The first part of the work shows the fabrication of a fuel element for an experimental reactor for production of radio-isotopes (RAEP). Its maximum power is 5 MW, the neutron flux 2×10^{13} n/cm² sec., and it is cooled with ordinary water. The fuel element is of the MTR type. The core is made of an aluminium -15% uranium alloy. The uranium is 90% enriched. The cladding material is aluminium 1100. The well known method of "picture frame" was utilized to manufacture it.

The alloy for the core is obtained by a method developed in the Department of Metallurgy, Argentine Atomic Energy Commission. It consists of the direct reduction of uranium hexafluoride to an aluminium uranium alloy, 20 to 23 weight percent uranium. This alloy is remelted in an induction furnace, brought to composition and hot rolled at 580°C, to 3 mm thickness.

The core and frame for the picture frame is cut with the same die. The material is annealed, pickled, washed and dried. Then, the internal faces of the side sheets are wire brushed, as well as the core and frame. Finally, the assembly is sealed by an U-shaped indentation around the core, which will prevent the oxidation of the inner face by further heating as well as displacements between the side sheets and the core while rolling.

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The whole set is hot rolled to 2.5 mm thickness, then cold rolled to 1.30 mm (final thickness of the element). A blister test is performed. The plates are flattened in a rolling straightener and then X-rayed to locate the core and verify dimensional tolerances.

Then, the plates are cut to their final size and identified. The element is transversally bent, and a chromatizing treatment is given as last finishing step. Finally they are placed in polyethylene bags.

The second part of the paper refers to the manufacturing process of a fuel element for the reloading of the RA-1 reactor. It is a cylindrical element, aluminium clad, sealed in both ends. The core is a rod 7,6 mm in diameter and its composition is 80% of 19.7% enriched UO_2 and 20% C, at least 50% of which is graphite. The U_{235} concentration is $0.50 \text{ g/cm}^3 \pm 0.01 \text{ g/cm}^3$.

The working conditions are: maximum power 500 watts per element; maximum temperature of coolant 50°C ; neutron flux $5 \times 10^{11} \text{ n/cm}^2 \text{ sec}$.

The core is made by hot extrusion of a powder mixture of the following composition: 70% UO_2 - 14.5% graphite - 15.5% pitch.

The volatiles are eliminated by degassing in vacuum, heating slowly to 700°C . The ends are welded, leaving a hole in one of them with the following purposes:

- a) avoid blow holes while welding,
- b) eliminate adsorbed gases,
- c) introduce He.

This hole is pressure sealed and manually welded. The thermal transfer is improved by hydrostatic pressing of the cladding at 150 kg/cm^2 and 350°C . The corrosion resistance is improved by a chromatizing process.

The third part of this paper briefly describes the manufacturing process of a cylindrical fuel element with a U_3O_8 - core and Al clad obtained by co-extrusion. From the extrusion results a sealed element with the following advantages: high efficiency, easy accountability of fissile material, simplicity and low cost of manufacturing.